

Appl. No. 10/699,440  
Amdt. dated June 26, 2006  
Reply to Office Action of May 08, 2006

**Amendments to the Claims:**

This listing of claims will replace all prior versions, and listings, of claims in the application:

**Listing of Claims:**

1 Claim 1 (currently amended): A film surface imprinted with  
2 nanometer-sized particles to produce micro- and/or nano-  
3 structured electron and hole collecting interfaces, comprising;  
4 at least one transparent substrate;  
5 at least one photoabsorbing conjugated polymer applied on a  
6 first said substrate, wherein said conjugate polymer includes  
7 polybutylthiophene (pbT);  
8 a ~~sufficient amount~~ plurality of nanometer-sized particles  
9 including multiwalled carbon nanotubes (MWNT) ~~to,~~ wherein said  
10 plurality of nanometer-sized particles including said multiwalled  
11 carbon nanotubes produce a charge separation interface;  
12 at least one transparent polymerizable layer including a  
13 sol-gel or monomer,  
14 said MWNT embedded in said conjugated polymer to produce a  
15 mixture and applied on a second said substrate to form a MWNT

Appl. No. 10/699,440  
Amdt. dated June 26, 2006  
Reply to Office Action of May 08, 2006

bearing surface film layer to form a stamp surface;

wherein said stamp surface is imprinted into the surface of  
said polymerizable film layer to produce micro- and/or nano-  
structured electron and hole collecting interfaces;

polymerizing said polymerizable film layer to promote  
shrinkage to form a conformal gap between said MWNT stamp surface  
and said surface of said polymerizable film layer; and

filling said gap with at least one photoabsorbing material  
to promote the generation of photoexcited electrons and transport  
to the charge separation interface.

Claim 2 (Original): The film according to claim 1, wherein either  
said polymerizable layer and said conjugated polymer is applied  
by processes comprising at least one of spin-coating, dip-  
coating, spray-coating, flow-coating, doctor blade coating, and  
screen-printing.

Claim 3 (currently amended): The film according to claim 1,  
wherein said nanometer-sized particles comprise at least 1.5 mg  
of said multiwalled carbon nanotubes having average particle  
sizes of about 1 nm to about 100 nm in diameter and up to about 1

Appl. No. 10/699,440  
Amdt. dated June 26, 2006  
Reply to Office Action of May 08, 2006

5 nm to about 1 cm in length.

1 Claim 4 (original): The film according to claim 3, wherein said  
2 nanometer-sized particles having average particle sizes of about  
3 1 nm to about 100 nm in diameter and up to about 1 nm to about  
4 500 nm in length.

1 Claim 5 (currently amended): The film according to claim 1,  
2 wherein said nanometer-sized particles further comprises at least  
3 one of ~~SWNT~~ single-walled carbon nanotubes (SWNT), and  
4 nanocrystals of semiconductor materials.

1 Claim 6 (Original): The film according to claim 5, wherein said  
2 nanocrystals of semiconductor materials comprises at least one of  
3 CdSe, metal nanowires, and metal-filled carbon nanotubes.

1 Claim 7 (Original): The film according to claim 1, wherein  
2 applying said polymerizable film layer ranging in thickness from  
3 about 1 nm to about 1 mm.

Appl. No. 10/699,440  
Amdt. dated June 26, 2006  
Reply to Office Action of May 08, 2006

1 Claim 8 (Original): The film according to claim 1, wherein  
2 applying said conjugated polymer mixture ranging in thickness  
3 from up to about 100 nm.

1 Claim 9 (Original): The film according to claim 1, wherein said  
2 polymerizable layer comprises at least one monomer film.

1 Claim 10 (Original): The film according to claim 1, wherein said  
2 polymerizable layer comprises at least one sol-gel film.

3 Claim 11 (Original): The film according to claim 1, wherein said  
4 sol-gel includes absolute alcohol and ultrapure water in a ratio  
5 of about (1:0.025) and said metal oxide includes titanium oxide  
6 and/or zinc oxide.

1 Claim 12 (Original): The film according to claim 1, wherein said  
2 monomer comprising at least one of oxadiazole, aniline, and  
3 pyrrole.

1 Claim 13 (Original): The film according to claim 1, wherein said

Appl. No. 10/699,440  
Amdt. dated June 26, 2006  
Reply to Office Action of May 08, 2006

photoabsorbing material comprises at least one of thermotropic  
liquid crystalline materials, polybutylthiophene  
(pbT)/chlorobenzene, and polyelectrolytes.

Claim 14 (currently amended): A film surface imprinted with  
nanometer-sized particles prepared by a process to produce micro-  
and/or nano-structured electron and hole collecting interfaces,  
comprising:

- providing at least one transparent substrate;
- providing at least one photoabsorbing conjugated polymer;
- providing a ~~sufficient amount~~ plurality of nanometer-sized  
particles to produce a charge separation interface;
- providing at least one transparent polymerizable layer  
including a sol-gel or monomer;
- embedding said nanometer-sized particles in said conjugated  
polymer;
- applying said polymerizable layer on a first said substrate  
to form a charge transport film layer;
- applying said conjugated polymer/nanometer-sized particle  
mixture on a second said substrate to form a nanometer-sized  
particles bearing surface film layer, wherein said nanometer-

Appl. No. 10/699,440  
Amdt. dated June 26, 2006  
Reply to Office Action of May 08, 2006

18 sized particles form a stamp surface;  
19 imprinting said stamp surface into the surface of said  
20 polymerizable film layer to produce micro- and/or nano-structured  
21 electron and hole collecting interfaces;  
22 polymerizing said polymerizable film layer to promote  
23 shrinkage to form a conformal gap between said stamp surface and  
24 said surface of said polymerizable film layer; and  
25 filling said gap with at least one photoabsorbing material  
26 to promote the generation of photoexcited electrons and transport  
27 to the charge separation interface.

1 Claim 15 (Original): The film according to claim 14, wherein said  
2 imprinting includes compressing and thereafter, solidifying said  
3 stamp surface into said surface of said polymerizable layer.

1 Claim 16 (currently amended): The film according to claim 14,  
2 wherein said nanometer-sized particles comprise at least 1.5 mg  
3 of multiwalled carbon nanotubes having average particle sizes of  
4 about 1 nm to about 100 nm in diameter and up to about 1 nm to  
5 about 1 cm in length.

Appl. No. 10/699,440  
Amdt. dated June 26, 2006  
Reply to Office Action of May 08, 2006

1 Claim 17 (Original): The film according to claim 16, wherein said  
2 nanometer-sized particles having average particle sizes of about  
3 1 nm to about 100 nm in diameter and up to about 1 nm to about  
4 500 nm in length.

1 Claim 18 (currently amended): The film according to claim 14,  
2 wherein said nanometer-sized particles further comprises at least  
3 one of ~~SWNT~~ single-walled carbon nanotubes (SWNT), and  
4 nanocrystals of semiconductor materials.

1 Claim 19 (Original): The film according to claim 18, wherein said  
2 nanocrystals of semiconductor materials comprises at least one of  
3 CdSe, metal nanowires, and metal-filled carbon nanotubes.

1 Claim 20 (Original): The film according to claim 14, wherein  
2 applying said polymerizable film layer ranging in thickness from  
3 about 1 nm to about 1 mm.

1 Claim 21 (Original): The film according to claim 14, wherein  
2 applying said conjugated polymer mixture ranging in thickness  
3 from up to about 100 nm.

Appl. No. 10/699,440  
Amdt. dated June 26, 2006  
Reply to Office Action of May 08, 2006

4 Claim 22 (Original): The film according to claim 14, further  
5 comprising electrophoretically depositing said nanometer-sized  
6 particles onto said polymerizable layer.

1 Claim 23 (Original): The film according to claim 22, wherein said  
2 nanometer-sized particles include  $\text{TiO}_x$  nanometer-sized particles.

1 Claim 24 (Original): The film according to claim 14, wherein said  
2 sol-gel includes absolute alcohol and ultrapure water in a ratio  
3 of about (1:0.025) and a metal oxide.

1 Claim 25 (Original): The film according to claim 24, wherein  
2 said metal oxide comprises at least one of inorganic metal salts  
3 and metal organic compounds.

1 Claim 26 (Original): The film according to claim 25, wherein  
2 said metal organic compounds include metal alkoxides comprising  
3 at least one of titanium isopropoxide and zinc butoxide.

1 Claim 27 (Original): The film according to claim 14, wherein  
2 said monomer comprising at least one of oxadiazole, aniline, and

Appl. No. 10/699,440  
Amdt. dated June 26, 2006  
Reply to Office Action of May 08, 2006

3 pyrrole.

4 Claim 28 (Original): The film according to claim 14, wherein  
5 said substrate acts as an electrode by comprising a coating of at  
6 least one transparent metal oxide including  $\text{SnO}_2\text{:F}$ ,  $\text{SnO}_2\text{:In}$   
7 (ITO), and Au.

1 Claim 29 (Original): The film according to claim 14, wherein  
2 said substrate acts as an electrode by comprising a coating of at  
3 least one transparent metal oxide being conducting polymers  
4 including polythiophenes, polypyrroles, polyanilines, and  
5 polybutylthiophenes.

1 Claim 30 (Original): The film according to claim 14, wherein  
2 said conjugated polymer includes pbT dissolved in chlorobenzene.

1 Claim 31 (Original): The film according to claim 14, wherein  
2 said photoabsorbing material comprises at least one of  
3 thermotropic liquid crystalline materials, polybutylthiophene  
4 (pbT)/chlorobenzene, and polyelectrolytes.

Appl. No. 10/699,440  
Amdt. dated June 26, 2006  
Reply to Office Action of May 08, 2006

1 Claim 32 (Original): The film according to claim 14, wherein  
2 said substrate comprises at least one of silicon, silicate,  
3 plastic, and plastic-like materials.

4 Claim 33 (Original): The films surface imprinted with nanometer-  
5 sized particles are obtained by the process defined in claim 14.

1 Claim 34 ((Original): The film according to claim 1, wherein said  
2 film being utilized in a photovoltaic device or other light  
3 guiding device.

Claim 35 (canceled).

Claim 36 (canceled).